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Parasites from Gizzard Shad, Dorosoma cepedianum, in Lake Charleston, Illinois

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PARASITES FROM GIZZARD SHAD, DOROSOMA CEPEDIANUM,

IN LAKE CHARLESTON, ILLINOIS

(TITLE)

BY

FRANCIS M. YABAI KAIKUMBA

B.A. BEREA COLLEGE

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IN LAKE CHARLESTON, ILLINOIS

Presented by

FRANCIS M. YABAI KAIKUMBA

a candidate for the degree of Master of Science

and hereby certify that in their opinion it is acceptable.

6 SEPTEMBER 197[illegible]

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TABLE OF CONTENTS

LIST OF TABLES

Parasites from Gizzard Shad, *Dorosoma cepedianum*, in Lake Charleston, Illinois

Abstract: Eighty gizzard shad (*Dorosoma cepedianum*) from Lake Charleston, Charleston, Illinois were examined for parasites. Eight fish were parasitized. Three fish contained the acanthocephalan *Tanaorhamphus longirostris*, three fish harbored cestodes of the genus *Glaridacris* and two fish had the nematode *Camallanus oxycephalus*. The latter is here reported for the first time from gizzard shad. Twenty fish were infected with the fungus *Saprolegnia* sp. The numbers of helminth parasites harbored by shad are less than reported for other forage fish. However, the incident of parasitism reported in this study is greater than that reported by previous workers.

It is important to understand the ecological relationships of valued game fishes and the fish serving as food for such game fishes. Studies of the parasites in a fish species may contribute to an understanding of its ecology because parasites may be closely related to a host's feeding habits and habitat.

In lakes and streams, the gizzard shad, *Dorosoma cepedianum*, is utilized as food for largemouth bass, black crappie, and walleye (Kutkuhn, 1958). No study of the parasites of this major forage fish in Illinois has been reported. Therefore, this study of the parasites of the gizzard shad in Lake Charleston, Coles County, Illinois was undertaken. Lake Charleston is a four hundred-acre lake on the Embarrass River, serving as a city water supply and for recreation.

METHODS

Fish were collected by electrofishing. Each fish was weighed and classified adult or juvenile according to criteria established by Miller (1960). Sex was determined after examining the reproductive organs. Immediately following collection pithed fish were examined for ectoparasites using a dissection microscope to scan the body surface, gills, and scrapings from the body, mouth and anus.

Oral tissue scrapings and mucous scrapings from areas of apparent injury were put into jars containing about 50 to 70 mls. of physiological saline and well shaken. The mixture was allowed to decant for ten minutes and the sediment examined for parasites. Gills of all the fish were removed and placed in physiological saline and treated in the same manner as for mucous scrapings.

The body cavities of the hosts were opened and examined for cysts and helminths. The gastro-intestinal tract was removed, cut in three sections, opened, and scanned for endoparasites. Gut contents and mucosal scrapings were added to a jar of physiological saline and the mixture treated as for scrapings and gills.

All helminths, except acanthocephalans, were killed and preserved in 70% ethanol with 2% glycerine. Acanthocephalans were placed in distilled water until the hook-bearing proboscis was extruded, killed in warm (70°C) formalin and stored in 70% ethanol.

Nematodes and acanthocephalans were examined in lactophenol on microslides. Standard staining techniques were used for cestodes.

Helminths were identified using Yamaguti (1959, 1961, 1963), Hoffman (1967), and Yorke and Maplestone (1962). Fungal mycelia in mucous scrapings were identified according to keys in Hoffman (1967).

RESULTS

Eighty gizzard shad were collected and examined for parasites. One species of nematode, one species of acanthocephalid, and one species of cestode worm were found. One kind of fungus was observed. No trematode or protozoan parasites were recovered.

The nematode, Camallanus oxycephalus, Ward and Magath, 1916, was present in the small intestine of two female fish. In both cases, only one worm (female) per host was recovered. The nematode is red with a slitlike mouth that lacks lips. A buccal capsule is present with two lateral shell-shaped chitinous valves. The valves have on their inner surface, parallel longitudinal ribs. A chitinous trident shaped supporting process is located at the point where the valves meet. The buccal capsule is surrounded by a chitinous circular collar at its entry into the esophagus. The latter has a short muscular anterior region and a long posterior region that is enlarged at its end. The length of Camallanus oxycephalus is 10 mm.

Acanthocephalan worms identified as Tanaorhamphus longirostris (Van Cleave, 1921) occurred in the upper one-third of the small intestine of three hosts. These parasites were firmly imbedded in the intestinal mucosa by their spiny proboscises. The number of parasites per infected host was one and all were females. Tanaorhamphus longirostris is a medium-sized acanthocephalan, and has a sub-cylindrical trunk with the hypodermic giant nuclei mostly in the mid dorsal line.

It has a fairly long and cylindrical proboscis armed with sixteen rows of ten hooks each. The proboscis has a ganglion at its base and the long slender leminisci have very few nuclei. The specimens are female and the eggs are elongate oval.

Specimens of the cestode worm obtained in this study were identified only as *Glaridacris* sp. Cooper, 1920. All worms are monozoic and about 2 mm long. The well-defined scolex has six bothria-like depressions which are not very evident. The uterus does not extend anterior to the cirrus pouch, and the latter opens ventrally into the atrium. The H-shaped ovary is medullary. The worms occurred in the lower end of the intestine of the fish.

On twenty fish, cottony masses of fungal mycelia were observed on areas of apparent abrasion. A detailed identification of this fungus down to species level was not made. But under low magnification the fungus was observed to consist of a mass of non-septate filaments each of which was 20 u in diameter. The filaments of older infections terminated in club-like sporangial enlargements. The fungus is *Saprolegnia*.

Results are tabulated in Table 1.

Table 1. Parasites recovered from 80 gizzard shad (*Dorosoma cepedianum*) in Lake Charleston, Charleston, Illinois, 1972.

	% of infected hosts	No. of infected hosts	No. of parasites found	Location	Age of host
NEMATODA					
Camallanus oxycephalus	2.5	2	2	Intestine	Adult
ACANTHOCEPHALA					
Tanaorhamphus longirostris	3.8	3	3	Intestine	Adult
CESTODA					
Glaridacris sp.	3.8	3	3	Intestine	Adult
PHYCOMYCETES					
Saprolegnia sp.	25.0	20	-	Body surface	Adult

DISCUSSION

Compared to other species of fish that have been studied, the gizzard shad has a low incidence of parasitism. Ward (1912) examined four individuals and found one cestode, one acanthocephala and no nematodes. Bangham and Hunter (1939) examined five specimens and found only one unidentified larval nematode. Van Cleave (1919), in a search for acanthocephala from the Illinois River, recovered only two species of helminths, *Tanaorhamphus longirostris*, and *Gracilisentis gracilisentis* from 164 gizzard shad.

Essex and Hunter (1926) found no helminths in 107 gizzard shad from the Rock and Mississippi rivers. According to the authors, "The feeding habits of the shad are such as to preclude the acquiring of an extensive parasitic fauna. Since it feeds largely on vegetable debris at the bottom of streams and lakes, very seldom ingesting animal food, there is little opportunity for parasites which have an extremely complex life cycle, to find it a suitable host."

Miller (1960) remarked that "the species (*Dorosoma cepedianum*) appears to be unusually free from parasites from which it is undoubtedly protected by its herbivorous food habits." Results of the work done by Jester and Jensen (1972) support the contentions of Miller (1960), and Essex and Hunter (1926). Jester and Jensen studied the life history and ecology of gizzard shad in the Elephant Butte Lake in New Mexico and found one ectoparasite, *Argulus* sp., on three fish and an acanthocephalan, *Gracilisentis* sp., from one fish. They noted that shad from the lake were host to water-fungus, *Saprolegnia parasitica*.

The results of this study support the contentions of authors cited above. The total incidence of infection by helminths is 10% and fungal infection is 25%. Such figures are low compared to those obtained from most other fishes (Essex and Hunter, 1926). However, Miller's view that such a low parasitic infection is due to the herbivorous food habits of the fish cannot be supported here because gizzard shad feed on both zooplankton and phytoplankton. The preponderance of either of the two depends on availability (Jester and Jensen, 1972).

Bangham (1941b) stated that the young shad in Buckeye Lake, Ohio, often bear a heavy infection of myxosporidians. Ten out of twelve young fish collected at the lake by Bangham were infected whereas all adult individuals were free of myxosporidian cysts. Careful examination of the fish collected in the present study revealed no such cysts. It should be observed that all the fish were adults.

Myxosporidian cysts are usually near the surface of the host's skin. With the lapse of time and as the host develops, the cysts break thus releasing the spores. If not, the spores remain in the body until another fish feeds on the infected host. Young shad are often fed upon by game fish. Thus the infected young shad may be fed upon before adulthood. Those that survive may get rid of their infection as the cysts break, before adulthood. Table 2 summarizes all the helminth parasites recovered from gizzard shad from 1913 to 1967.

Camallanus oxycephalus reported in this study has been reported from several fishes in North America -- black and white crappies, bluegill, largemouth bass, yellow perch, sauger, white bass, northern pike, channel catfish, paddle fish, bowfin and brown trout (Hoffman, 1967). But it has never been reported from the gizzard shad.

Baer (1951), outlined the life history of Camallanus as including an egg stage, three successive larval stages (L_1, L_2, L_3), and an adult stage. The first stage larva develops in the uterus and is consequently eliminated into the water. It is swallowed by a copepod and passed down into the body cavity of the latter. Here it further develops into the L_2 stage through the L_3 stage. If an infected copepod is eaten by a fish or any other predator the larva escapes into the latter and becomes an adult.

According to Dogiel (1958), the life history of Camallanus utilizes a crustacean intermediate host and a carrier host. The latter corresponds to what Baer (1951) calls the paratenic host. The latter host may be optional. McDaniel (1963) found that the carrier host of the parasite from turtles could be damselfly nymphs, dragonfly nymphs, or even young fish. It is possible that Camallanus oxycephalus utilizes a similar carrier or paratenic host.

Since the gizzard shad is a plankton feeder (Jester and Jensen, 1972), specimens of the fish found to be infected with C. oxycephalus, in this study, may have obtained the parasite through feeding on infected copepods. Infection can occur in both young and adult shad. Accepting Baer's statement (1951) that the carrier host is optional, it is possible that such a host is by-passed in this instance. Dogiel (1958) also believed that the viviparous Camallanus can develop without a carrier host.

There is a possibility also that the gizzard shad may have obtained the parasite through a carrier host, like a damselfly nymph, or a dragonfly nymph, or even a young fish as McDaniel (1963) stated. The shad is known to migrate periodically from the top to the bottom zones of lakes and streams (Jester and Jensen, 1972). As it dredges along the bottom of the lake, it leaves its mouth open. In this way several unavoidable materials including damselfly and dragonfly nymphs are passively ingested.

This is evidenced by the fact that the author often encountered skeletal remains of such insect nymphs in the gut contents of the fish.

Tanaorhamphus longirostris was reported from *Dorosoma cepedianum* in the Illinois River by Van Cleave in 1919. The acanthocephalan, according to Van Cleave, showed a strong evidence of restriction to the gizzard shad from that region. Bangham (1942) found the same parasite in the *Dorosoma cepedianum*, *Ictalurus anguila*, and *Ictalurus punctatus* in Tennessee.

Compared to the 75.4% infection reported in Van Cleave's work (1919), results in the present study show only 3.8%. However since gizzard shad secures its acanthocephala only through feeding upon infected copepods, the degree to which the fish is parasitised depends on the number of infected copepods eaten. Also, according to Van Cleave, seasonal conditions influence infection.

Glaridacris is a caryophyllid tapeworm that is common among suckers (Hoffman, 1967). A species, *G. confusus* was recovered from *Dorosoma cepedianum* by Fischthal (1947, 1950) in Wisconsin. It is possible that the three specimens found in the present study are *G. confusus*. The parasite inhabits the intestine of vertebrate hosts and tuberficid oligochaetes serve as intermediate hosts.

Dogiel (1958) stated that the abundance of a host influences number and diversity of parasites. Due to its high reproductive potential and rapid growth rate, the gizzard shad is known for its tendency to over-populate waters. In this regard, the fish is expected to harbor a great abundance and variety of parasites because the latter may have the opportunity to spread from one host to another. Results in this study and others negate this view. Despite high population numbers, gizzard shad from Lake Charleston show the general freedom from parasites reported by other workers.

In conclusion, to clarify this situation, it is recommended that some careful investigation be made into the receptiveness of gizzard shad to various parasites. Such a work may somehow answer the question of low parasitic incidence and also throw light on the ecological status of the fish.

Table 2. Parasites recovered from gizzard shad (*Dorosoma cepedianum*) in U.S.A. from 1913 to 1967.

Species	Location in host	Type of report and geographical distribution	Author
PROTOZOA			
Plistophora cepedianae	Viscera	Case report Ohio	Putz, Hoffman & Dunbar, 1965
TREMATODA			
Clinostomum sp.	Muscles & skin	General report U.S.A. & Asia	Leidy, 1856 Bangham, 1951, 1955 Fischthal, 1945, 1950
Diplostomulum sp.	Muscles	Case report No. American & Europe	Hoffman, 1960
Mazocracoides megalocotyle	Gills	Case report Tennessee, U.S.A.	Price, 1958
Mazocracoides oletangienses	Gills	Case report Ohio, Tennessee, U.S.A.	Sroufe, 1958
Mazocracoides similis	Gills	Case report Ohio, Tennessee, U.S.A.	Price, 1959
CESTODA			
Glaridacris confusus	Intestine	Case report Mississippi, Iowa	Hunter, 1927
Protocephalus sp.	Intestine	General report U.S.A.	Hoffman, 1967

Table 2. (Continued)

Species	Location in host	Type of report and geographical distribution	Author
ACANTHOCEPHALA			
Gracilisentis gracilisentis	Intestine	Case report Illinois, Mississippi	Van Cleave, 1919, 1931
Tanaorhamphus longirostris	Intestine	Case report Illinois, Tennessee	Van Cleave, 1919 Bangham, 1942
Neoechinorhynchus longirostris	Intestine	Case report Mississippi	Van Cleave, 1931
CRUSTACEA			
Argulus alosae	Gills, Body surface	General report U.S.A.	Hoffman, 1967
Argulus appendiculosus	Gills, Body surface	General report U.S.A.	Hoffman, 1967
Ergasilus lanciolatus	Gills, Body surface	Case report Kentucky	Wilson, 1916

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